

STUDENTS' SECTION.

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NOTES ON USE OF ELASTIC AND VULCANITE. GRINDING WHEELS.

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The first abrasive wheels were natural stones. The use of these natural stone wheels was limited by the fact that they did not have the physical properties requisite for efficient use on metals, through want of proper machines and methods of application. The use of an abrasive wheel for grinding metals has always been taken as a fundamentally correct idea, and efforts toward the success of the same are seen first in the hydraulic cement wheels, which were made in imitation of the natural stones.

These failed even with the hardest of abrasive grains. The second step was the use of organic substances, which melt when heated, and are hard when cold. The shellac, resin, sulphur, and rubber bonded wheels were tried, and wheels bonded with rubber and shellac were, to a considerable degree successful, and have a special field of usefulness to-day.

Following the organic bonded abrasive wheels, there came the silicate of soda and the vitrified or (more correctly-speaking) the completely fused clay bonded wheels both of which rapidly gained favour.

To-day the metal trades have not only a variety of wheels from which to make a selection, but also have highly efficient machines. The development of the grain-

ing machines to their present day efficiency has played no small part in the history of the several kinds of grinding wheels, and finally in the special fields to which each kind is adapted.

To write exhaustively on the fields of utility for which each of the many types of wheels now serve, would take up as much space as a number of these short papers. This note is therefore confined to outlining the most important fields for the elastic and vulcanite abrasive wheels.

As the trade recognised the freer and cooler cutting qualities of the vitrified wheels on practically all grinding operations in the iron and steel industries, the elastic and vulcanite wheels were slowly but surely superseded. They are not, however, and probably will not be, entirely eliminated, since there is a field wherein their particular properties make them peculiarly efficient, and where a vitrified wheel can never successfully compete.

Manufacture.—The elastic bonds are composed of shellac and other gums, which completely fill the voids of the wheel. The vulcanite bonds are composed of rubber, as the name implies.

Elastic and vulcanite wheels are made by a pressing or rolling operation, and have a very dense structure; the abrasive grains being embedded in the bonding material. This does not permit of as fast grinding as is possible in wheels of a porous structure, containing a considerable number of clearance spaces or voids.

Some manufacturers cover the sides of their cutting-off wheels with a fine coating of fine abrasive grit or sand, to give the appearance of a good close uniform wheel structure. This coating comes off while making the first cut, in fact, it can be scratched away with a chip of wood, and is of no practical use. However, this coat-

ing on the sides of thicker wheels is used as a means of bringing the wheels into balance. It is not a good practice, however, at any time, because the varying thickness of the wheel will cause it to run out of true on the sides.

Clearance.—The effect of clearance in these wheels has come up at various times. The idea being that such a wheel would be faster in cutting. A wheel of this kind was made up at the factory for test, and looked like the bottom of a collander, being filled with small holes.

When tested, this wheel was found to cut fast with a small wheel wear, and working as smooth as a regular wheel. However, if the proper grain and grade of wheel and correct wheel speeds have been selected, there is no particular advantage in using a wheel of this type. The elastic bond has a limited range of grades, a high tensile strength, and considerable elasticity. The vulcanite or rubber bond has the general characteristics of the elastic bond, but its grade or degree of hardness cannot be varied as extensively, and therefore its uses are more limited.

Advantage is taken of this property of elasticity to make very thin wheels.

Elastic and vulcanite wheels are made as thin as 1-32 in. thick up to 4in. diam.; 1-16in. thick up to 8in. diam., and 3-32in. thick up to 12in. diam. Wheels of very fine grit and small diameter have been made as thin as 1-64 in. Solid, elastic wheels are being made commercially as large as 26in. diam. and 2in. thick, while vulcanite wheels are being made 16in. diam., and 2in. thick.

Uses.—The thin wheels are used for slotting and cutting off stock. Tubing, pipes, wire, thin sheets of brass or steel, in fact most materials which are difficult to hold for cutting by regular tools or saws, are cut off very easily and efficiently by these wheels.

The thicker wheels are used for saw gumming, grinding between the teeth of gears, sharpening moulding cutters, wood working tools, etc. They are also used for cutlery work, and roll grinding, where a very smooth polished surface is required.

Conditions of Use.—Both types of wheels may be safely run in water. Elastic wheels should not be used in oil or caustic soda. The oil will soften the bonding material, and the wheel will quickly wear down, while caustic soda will disintegrate the wheel structure. This does not hold with vulcanite wheels, as they may be run in both these lubricants without injury to or the disintegration of the bond and abrasive.

For cutting off work, a wheel speed of 9,000 to 11,000 surface feet per minute has been found most efficient; for most operations other than cutting off, a wheel speed of 5,000 to 6,000 feet per minute is recommended. Cutting-off wheels will do work which no edged cutting-off tool or saw can do, that is, cut off unannealed high speed steel lathe tools with a minimum amount of waste. The machines for these wheels are very simple, having merely a support for the wheel, and another for the piece to be cut off. A few words concerning the machines these wheels are mounted on may not be out of order.

For cutting off small light pieces, the wheel is stationary, and the work is carried to it, while on long unwieldy pieces the work is kept stationary and the wheel brought to it.

These machines will cut off tubing or piping of any metal up to 3in. diam., and also pieces of any section and any metal up to 2in. diam. One big advantage being, that when cutting tubing it does not raise a burr on the inside as with a hacksaw.

Tests.—1in. and $\frac{1}{2}$ in. iron piping is cut off in 11 to 12 secs., and 6 to 7 secs. respectively, by a 30 grade 8 alundum vulcanite wheel.

In cutting through bars of machinery steel $1\frac{1}{2}$ in. x $\frac{1}{2}$ in. cross section, a 20 grade 3 alundum elastic wheel cut at the rate of 4.7in. per minute, while a vulcanite wheel made of 8 alundum 30 grade only cut 3.31in. of the same bar per min. The elastic wheel wore slightly more than the vulcanite.

To show the difference in cutting different metals, a test was made on a bar of gray cast iron, and a bar of machinery steel $1\frac{1}{2}$ in. x $\frac{1}{2}$ in. section, under the same pressure. A 30 grade 8 alundum vulcanite wheel cut through the steel in 25 seconds, while it cut through the cast iron in 18 seconds.

An illustration of the efficiency of abrasives over emery is shown in the following:—two wheels, one of emery, and one of alundum, were made to the same grain combination and grade. When tried on the same bar of steel under similar conditions, the emery wheel cut through 2.5in. of metal per minute, and the alundum wheel cut 3.62in. per minute, which shows 45 per cent. faster cutting ability with less wear for the alundum wheel. However, as a general rule, elastic wheels cut approximately 1-3 faster, but the wear is three times greater than vulcanite wheels.

Sometimes trouble is encountered by the wheels crumbling. This is due to one of three causes; the 1st being excessive heating which softens the bond. This may be eliminated by varying the pressure under which the work is applied to the wheel, or using a softer wheel; 2nd being too low wheel speed, which will cause the wheel to act softer and crumble under heavy pressure; 3rd too coarse a size grit for the operation in question, for which anyone would substitute a finer wheel.

These wheels are, in a way, self truing, and therefore give little trouble on this account. However, the more and the oftener the wheels get out of true, and knock against the material being ground, the faster they will cut through the material, but with greater wear.

For general purpose cutting-off wheels, where the speed of cutting is not a large factor, vulcanite seems to be the better wheel. However, for cutting off tempered tool steel or alloy steel, where cool cutting is the main consideration, then the elastic wheels can be used to better advantage on account of their softer grades, and resulting cooler grinding action.

While elastic and vulcanite wheels are being used somewhat on operations outside of slotting, grooving, nicking, and cutting off, they are slowly but surely being superseded by wheels manufactured by vitrified process. The more porous structure of the latter wheels allows of a much freer and cooler grinding action, with a proportionate increased production, which in these days of high efficiency, is the keystone of success. However, for slotting work, where a thin wheel is required, it will be impossible to replace wheels made by the elastic and vulcanite processes.